Space Weather Technical Forecast

Issued on Sunday, 28 November 2021 at 12:31 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: No significant activity expected.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was very low, with just minor B-class flares detected. There are currently three sunspot regions on the visible disc, with AR2898 (Cao/Beta) in the southwest persisting with one penumbral leading spot, but seeing some fading in its trailing group. AR2900 (Beta/Dai), also in the southwest quadrant, showed some increased magnetic complexity but remains with a Beta configuration for the time being. Newly numbered 2901 (Alpha/Axx) towards the northeast limb persists as a single uni-polar spot. A large filament region near the southwest limb remained stable during the period, but a further filament in the southwest erupted around 28/0200-0400 UTC, however no associated CME was evident. No other Earth-directed CMEs were evident in available imagery.

Solar Wind / Geomagnetic Activity: Solar wind parameters, as measured by DSCOVR at L1, were indicative of a weak CME arrival around 27/2150 UTC, with background wind speeds showing a sudden increase from 310 to 380 km/s, and becoming slightly elevated for a time 28/0200-0700 UTC, reaching 415 km/s at 28/0432 UTC. Density saw a sudden jump from 6 to around 20 ppcc as the CME arrived, before easing back towards below average values later in the period. Weak total IMF Bt became moderate to strong with the CME arrival, reaching 17 nT at times 28/0000-0300 UTC, and with the north-south component Bz seeing a maximum southward deflection of -16 nT at 28/0126 UTC. Phi angle switched from a positive (away from sun) to a negative orientation at 27/1839 UTC, with some further temporary rotations 28/0200-0300 UTC. In spite of the CME arrival, resultant geomagnetic activity remained at Quiet to Unsettled levels (Kp0-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) remained at background levels. High energy electron flux (greater than 2 MeV) as observed by GOES-16 decreased from moderate to background levels. The associated 24-hour integrated fluence remained below the Active threshold (1e8 integrated pfu), on a decreasing trend, with 3.07e7 integrated pfu recorded at 28/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be low or very low, with a chance of C-class flares from either of the two more complex active regions currently on the disc.

Solar Wind / Geomagnetic Activity: A CME from a filament eruption early on the 26 Nov has now been reassessed as likely missing, but with low confidence, giving a small chance of some impact at Earth late day 2 or day 3 (29 or 30 Nov). There may also be weak additional enhancements from coronal holes 22 or 24. Otherwise, slightly disturbed conditions from a weak CME arrival on 27th are expected to settle through day 1 (28th). Geomagnetic activity is likely to be Quiet to Unsettled, with a chance of isolated Active intervals at first, and again if we do see a glancing blow from the second CME later in the period.

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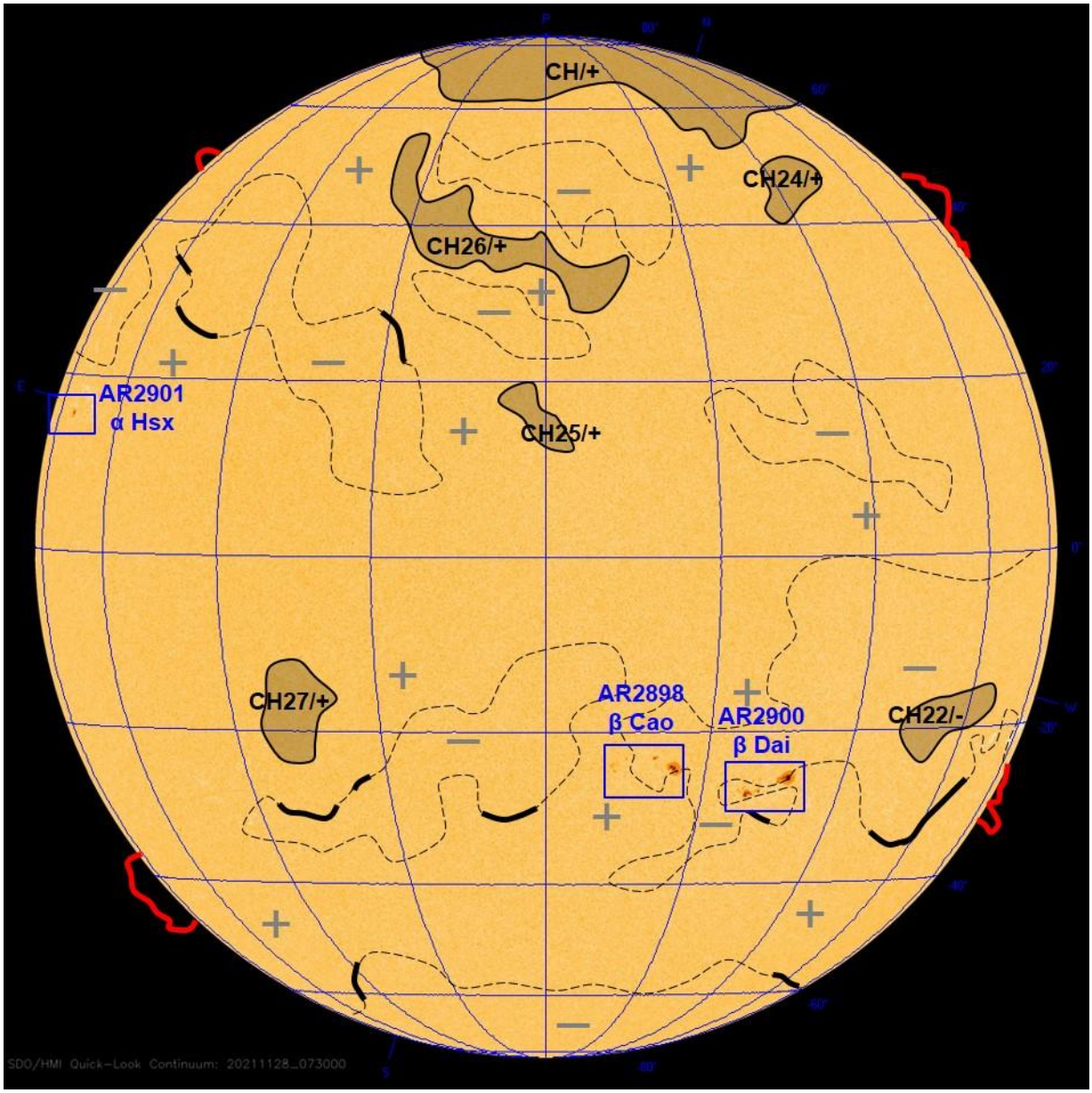
Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at background levels. The high energy electron flux (greater than 2 MeV) is likely to be at background to moderate levels, with a low confidence possible increase from day 2 (29th) due to recent CME activity. If this occurs, the fluence may rise as a result, but is currently expected to remain below the Active (1e8 integrated pfu) threshold.

Figure 1. Solar Analysis Valid 28/0800 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A CME arrived at L1 at 27/2150 UTC. This was due to a filament eruption which left the Sun at 24/1400 UTC. Whilst the bulk of material appeared to pass beneath the Earth, there is a component which impacted us. A further filament eruption was observed from the northeast disc around 26/0010 UTC, however analysis of any subsequent CME has been difficult due to limited good imagery. Whilst currently not expected, a glancing impact is possible late day 2 (29th) or on day 3 (30th). Despite the CME arrival, solar wind speeds remain at mostly ambient levels, although further weak enhancements are possible through the period from the fast winds of either coronal hole 22 or 24, or the above mentioned CME from 26th. Otherwise, any solar wind enhancements from the recent CME arrival are expected to decline through day 1 (28th).

Geomagnetic activity is likely to be generally Quiet to Unsettled through the next four days, but with a chance of isolated Active intervals at first, and if we do see a glancing blow from the second CME later in the period.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	5	10	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: Past 24 hours solar wind data at L1, showing the weak CME arrival at 27/2150 UTC.

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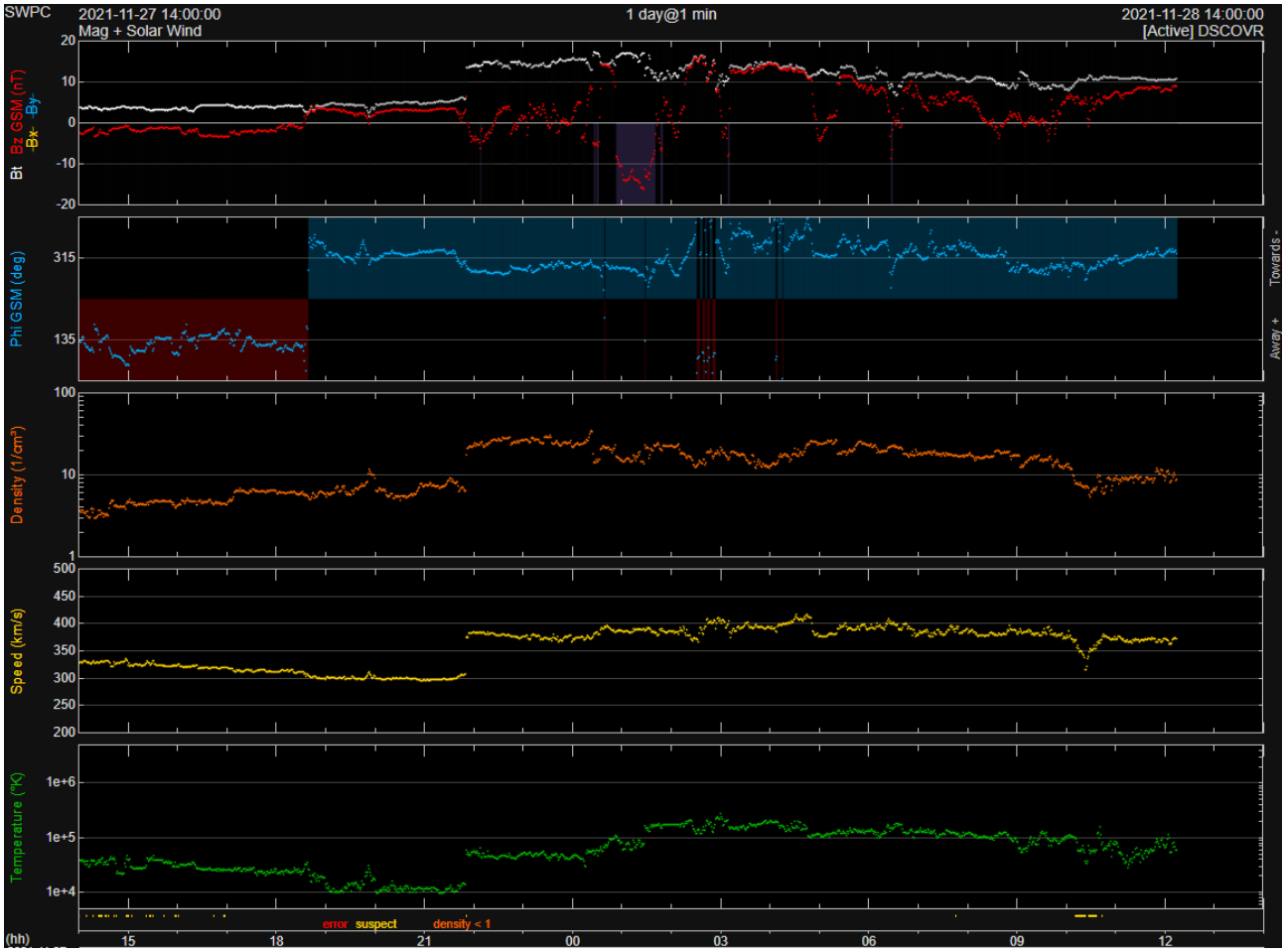
Space Weather Technical Forecast



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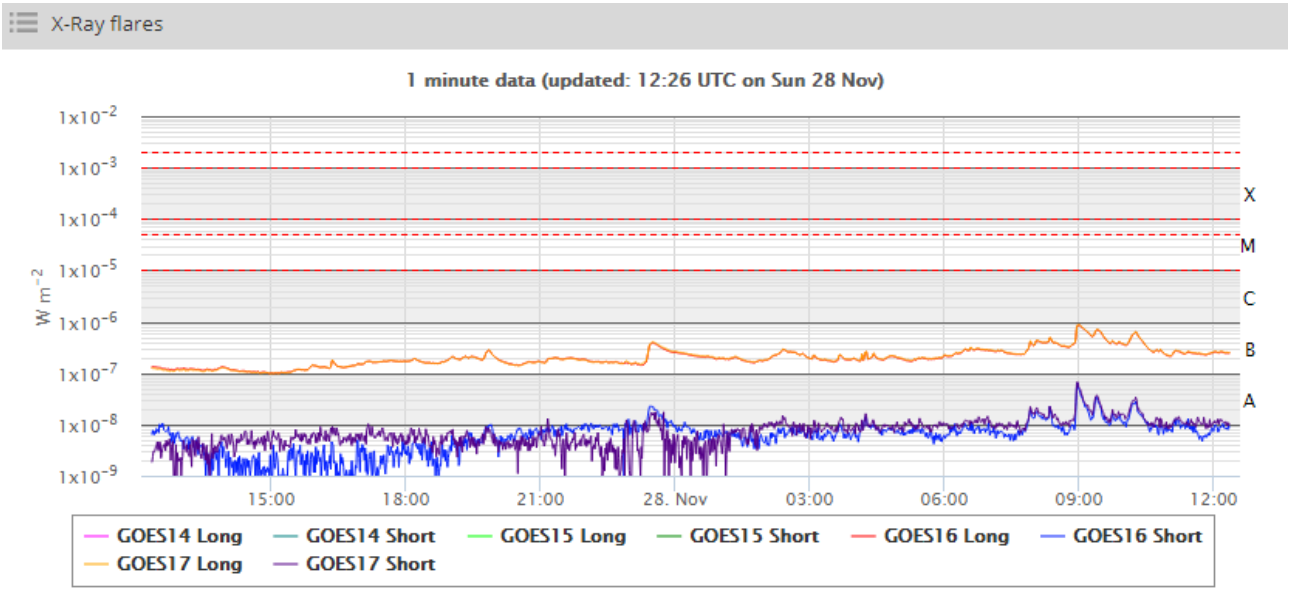
Radio Blackouts - X-Ray Flares:

There are now three active sunspot regions on the Earth-facing disc. AR2898 (Cao/Beta) and AR2900 (Dai/Beta) in the southwest quadrant are both relatively simple regions, with just some slight complexity, but little history so far of any flaring. A newly numbered region 2901 (Hsx/Alpha) has moved into better view towards the northeast limb. There is also a plage region near the southwest limb, that contains the remnants of ex-AR2899, and occasionally shows signs of slight pore development.

Solar Activity has been very low with only B-class X-ray flares observed by GOES-16/17. This may rise to low at times, with the two more complex regions on the disc both having sufficient magnetic flux for C-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	5	5	5	5
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: Low X-ray flux over the past 24 hours, as recorded at geostationary orbit



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is forecast to remain at background levels, with no solar radiation storms anticipated.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy electron flux as observed by GOES-16 reached moderate levels at the diurnal peak on 27 Nov, which was down from the previous day. Electron levels have decline further with the recent CME arrival likely causing a temporary suppression in the flux. However, there is the potential for moderate to high electron flux levels to return from day 2 (29th) onward. However, current relatively low solar wind speeds associated with the CME cast doubt on the likelihood of any significant flux increase.

The associated electron fluence is expected to remain below the active threshold through the period. It is likely there will be a continuing decline to start, with a possible rise into day 2 (29th) in response to the recent weak CME arrival, but this is low confidence.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	10	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: Latest MOSWOC REFM output, strong signal for flux remaining below the active threshold.

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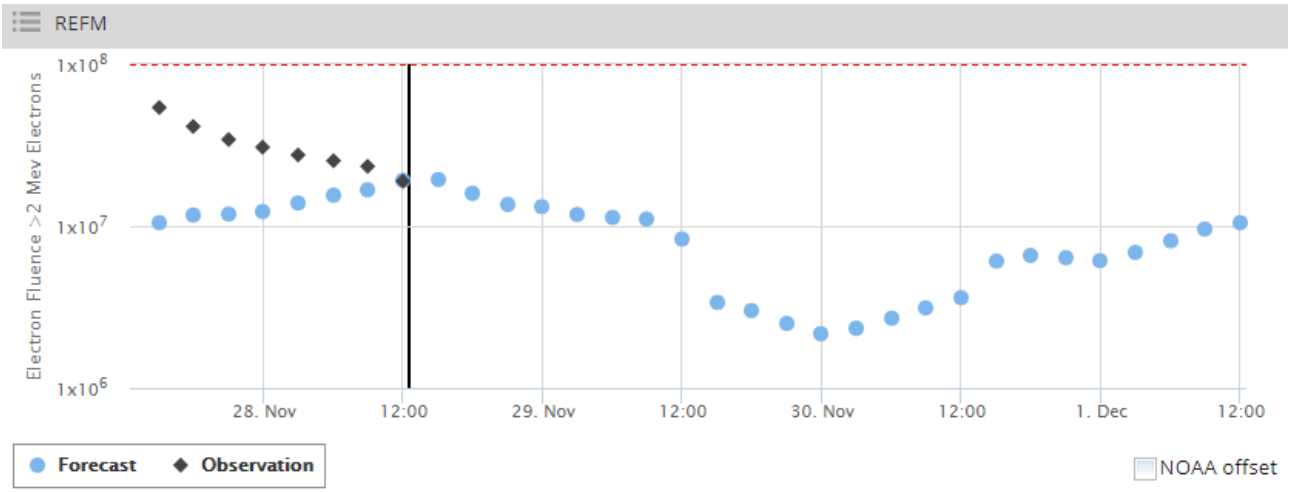

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